NATIONAL BIOLOGICAL INFORMATION INFRASTRUCTURE

NBII Enterprise Architecture

Section 3 – Design Architecture

Version 1.0

NBII Program
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Note: This document is Section 3 of a three section document entitled NBII Enterprise Architecture. The document sections include:

- *Section 1 – Introduction*
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- *Section 3 – Design Architecture*

3 Design Architecture

One of the principal goals of the NBII network is to provide seamless access to vast amounts of biological information that exist in the nation. The NBII, through a distributed network of nodes and delivery of data tools, provides users access to regional, national, and international biological data and information through a systematic and coordinated approach to handling biological information. The NBII Design Architecture documents the consolidated and integrated set of technologies and techniques that form the platform for delivering the required business functions to meet NBII's mission.

A number of initiatives, both tactical and strategic, are planned, under development, or currently deployed to implement an array of technologies that support NBII's missions, goals, and objectives. The NBII Design Architecture is a snapshot in time as it documents the baseline or "as is" combination of technologies, tools, techniques, and strategies that existed at a single point in time. Additionally, the NBII Design Architecture identifies the alignment with architecture initiatives of the USGS, DOI, and other federal/nonfederal partners involved with the NBII Program. The following sections describe the design architecture of the NBII.

- Section 3.1 – NBII Conceptual Architecture: This section provides a high-level conceptual view of the NBII Design Architecture and shows the relationship between the functions within the NBII Enterprise Framework and the core and enabling technologies.
- Section 3.2 – NBII Logical Architecture: This section describes core technology services (i.e., those functions that provide the basic infrastructure necessary to support all service layer functions of the NBII) and enabling technology services (i.e., those functions that support the delivery of specific NBII Framework services) and the alignment of those functions to the service components described in the Federal Enterprise Architecture (FEA) Service Reference Component Model (SRM) v1.0.
- Section 3.3 – NBII Technology Framework – This section describes the alignment of the core and enabling technologies to deliver all NBII services via a technology framework that illustrates alignment with the four technical tiers of the FEA Technical Reference Model (TRM) v1.0.
- Section 3.5 – NBII Technical Reference Model: This section identifies the standards, specifications, and technologies that support the delivery of NBII services.

3.1 NBII Conceptual Architecture

As discussed in the NBII Business Architecture, the NBII Enterprise Framework includes knowledge management, technology management, and program management services layers. Each layer includes a set of functions that support the realization of the NBII mission. Service layer functions include manual processes or processes supported by technology components. The NBII Conceptual Architecture is a logical depiction of the allocation of the service layer functions between core and enabling technology components. Core technology services includes those functions that provide the basic infrastructure necessary to support all service layer functions of the NBII and enabling technology services are those that support the delivery of specific NBII Framework services.

The NBII Solutions Architecture, shown in the figure below, provides the context for defining how core and enabling technology services interact to achieve NBII interoperability, flexibility, and scalability across NBII's heterogeneous and distributed community of biological information contributors and consumers.

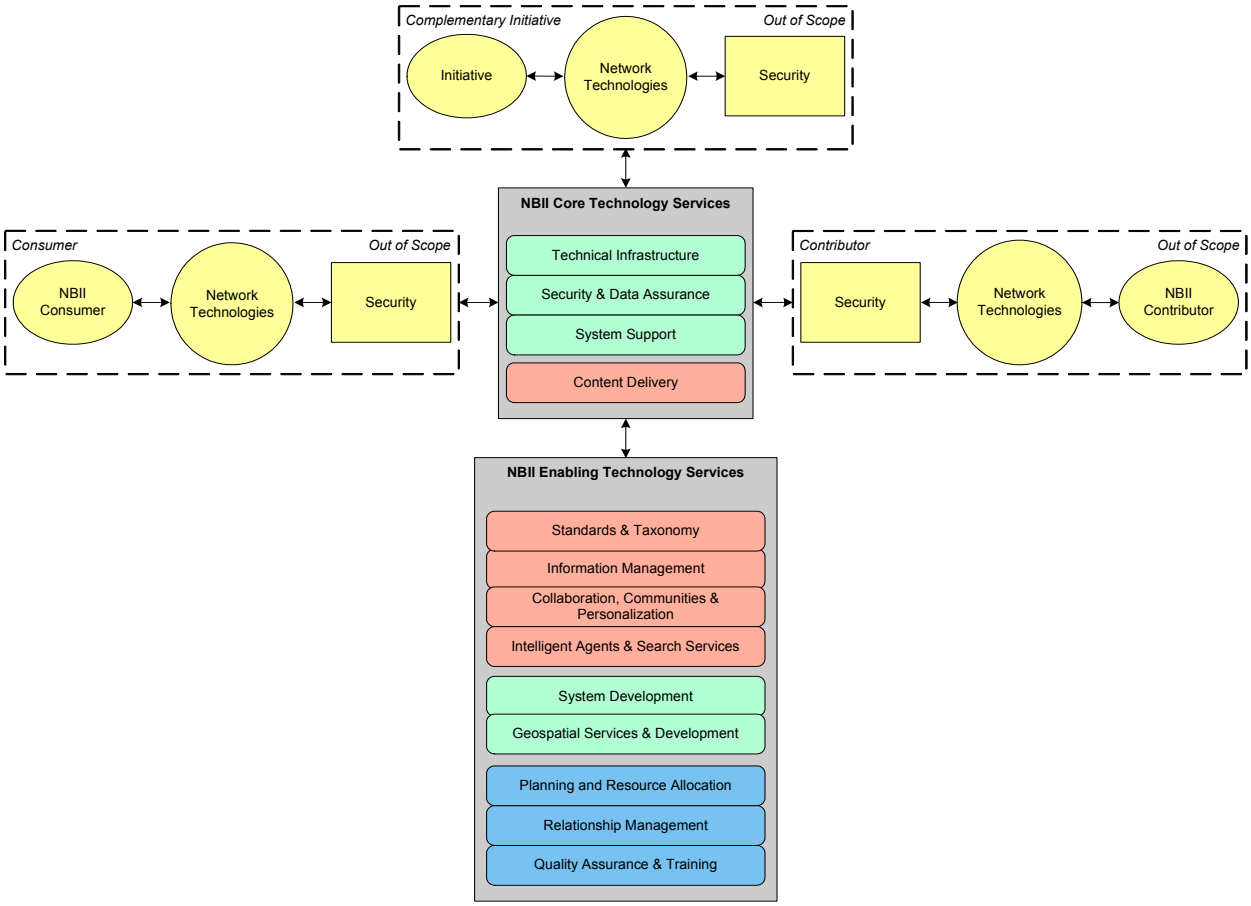

Figure 3-1. NBII Conceptual Architecture Model

3.2 NBII Logical Architecture

The NBII Enterprise Framework is a set of core and enabling services managed and delivered by the NBII Program that provide the foundation necessary to 1) support the creation and integration of the biological information harvested from NBII contributors and complementary initiatives, and 2) provide meaningful access to and use of that information by biological information consumers.

3.2.1 Core Technology Services

Core technology services include those components that provide the basic infrastructure necessary to support all service layer functions of the NBII. The four core technologies of the NBII include:

1. Technical Infrastructure
2. Security and Data Assurance
3. System Support
4. Content Delivery

The figure below illustrates the four core technologies and identifies those NBII service components, as defined by the FEA SRM, within each technology that represent predetermined functionality that are exposed through the NBII network.

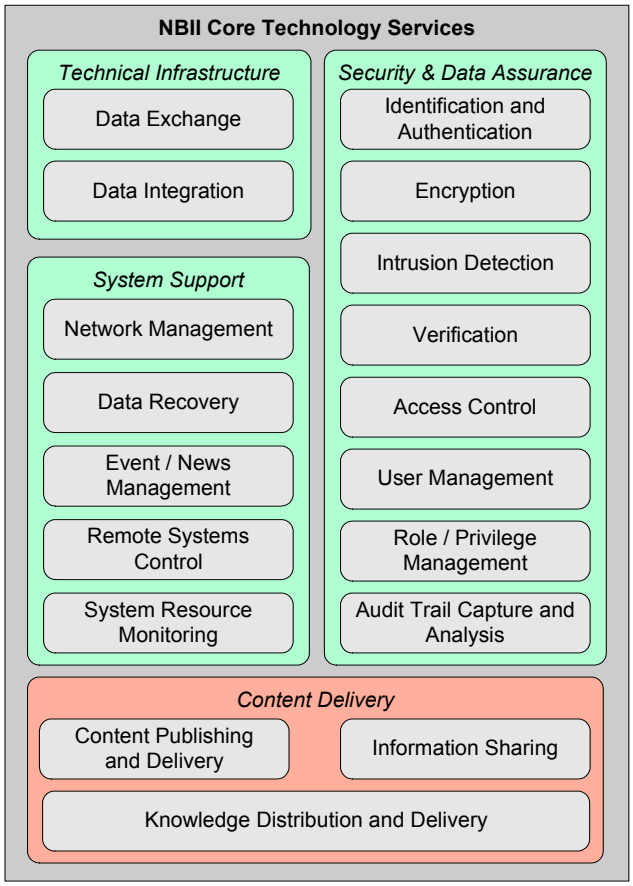

Figure 3-2. NBII Core Technology Services Logical Model

3.2.1.1 Technical Infrastructure

The technical infrastructure provides the framework that supports all functions of the NBII. It includes the physical hardware, transmission media, software, and tools used to connect biological information consumers and contributors with NBII services and to support the

processing of biological information received by and served via the NBII network. The NBII is actively involved in the exchange of information and communication between Federal and non-Federal organizations, biological information consumers and contributors, stakeholders, and third party participants. Additionally, the NBII creates an integrated virtual library of biological knowledge by systematically discovering, organizing, storing, and making available scientific data and information from diverse sources.

The technical infrastructure function includes a set of capabilities that support the exchange of information between systems that reside at geographically dispersed locations and the organization and transformation of data from separate data sources into a single source. The following table lists the service components, as defined by the FEA SRM, which are an integral part of the NBII technical infrastructure.

Table 3-1. Technical Infrastructure Components

SRM COMPONENTS	SRM DOMAIN	SRM SERVICE TYPE
Data Exchange – defines the set of capabilities that support the interchange of information between multiple systems or applications.	Back Office Services	Data Management
Data Integration - defines the set of capabilities that support the organization of data from separate data sources into a single source using middleware or application integration as well as the modification of system data models to capture new information within a single system.	Back Office Services	Development and Integration

3.2.1.2 Security and Data Assurance

Security plays a vital role in ensuring the integrity and maintaining the privacy of the biological content provided by NBII and in managing the permissions and connections to facilitate appropriate information sharing. Verifying identities, restricting access to appropriate resources, and maintain security logs detailing system access provide the protection necessary to assure the integrity of the data served via the NBII.

The security and data assurance function includes a set of capabilities that support the protection of the NBII's hardware, software, data, and related assets. The following table lists the service components, as defined by the FEA SRM, encapsulated within various business component systems that deliver a complete security and data assurance solution to NBII.

Table 3-2. System and Data Assurance Components

SRM COMPONENTS	SRM DOMAIN	SRM SERVICE TYPE
Identification and Authentication – defines the set of capabilities that support obtaining information about those parties attempting to log on to a system or application for security purposes and the validation of those users.	Support Services	Security Management

SRM COMPONENTS	SRM DOMAIN	SRM SERVICE TYPE
Access Control – defines the set of capabilities that support the management of permissions for logging onto a computer or network.	Support Services	Security Management
Encryption – defines the set of capabilities that support the encoding of data for security purposes.	Support Services	Security Management
Intrusion Detection – defines the set of capabilities that support the detection of illegal entrance into a computer system.	Support Services	Security Management
Verification – defines the set of capabilities that support the confirmation of authority to enter a computer system, application, or network.	Support Services	Security Management
User Management – defines the set of capabilities that support the administration of computer, application, and network accounts within an organization.	Support Services	Security Management
Role / Privilege Management - defines the set of capabilities that support the granting of abilities to users or groups of users of a computer, application, or network.	Support Services	Security Management
Audit Trail Capture and Analysis – defines the set of capabilities that support the identification and monitoring of activities within an application or system.	Support Services	Security Management

3.2.1.3 System Support

The USGS Center for Biological Informatics (CBI) provides the critical technical expertise necessary to support the cooperative sharing of the Nation's biological resources. An important component of the NBII Program is the system support services that support the management and execution of NBII functions and activities.

The systems support function includes a set of capabilities that support the collaboration and communication within and throughout the NBII organization; the usage, processing, and general administration of the delivered biological data and information; the transmission of data, messages, and information that facilitate the effective monitoring of the NBII infrastructure; and the administration and upkeep of the NBII's technology assets. The following table lists the service components, as defined by the FEA SRM, encapsulated within various business component systems that help support system continuity across the NBII.

Table 3-3. System Support Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Network Management - defines the set of capabilities involved in monitoring and maintaining a communications network in order to diagnose problems, gather statistics and provide general usage.	Business Management Services	Organizational Management
Data Recovery – defines the set of capabilities that support the restoration and stabilization of data sets to a consistent, desired state.	Back Office Services	Data Management

Event / News Management – defines the set of capabilities that monitor servers, workstations, and network devices for routine and non-routine events.	Support Services	Communication
Remote Systems Control – defines the set of capabilities that support the monitoring, administration and usage of applications and enterprise systems from locations outside of the immediate system environment.	Support Services	Systems Management
System Resource Monitoring – defines the set of capabilities that support the balance and allocation of memory, usage, disk space, and performance on computers and their applications.	Support Services	Systems Management

3.2.1.4 Content Delivery

A primary goal of the NBII is the publishing, delivery, and sharing of an abundant amount of well-presented, high-quality biological and ecological content organized for easy and useful access by biological information consumers. In additional to raw biological data, the NBII captures metadata describing different kinds of electronic content (e.g., datasets, documents, images, video, audio, databases, etc.) and makes them part of the NBII knowledge base while maintaining storage of that information in the native file formats.

The Content Delivery function includes a set of capabilities that support the distribution and management of NBII biological information. These capabilities include storage and retrieval of biological information via the NBII website or NBII Portal and the identification, gathering, and transformation of documents, reports and other sources into meaningful information. The following table lists the service components, as defined by the FEA SRM, which are an integral part of the NBII content delivery process.

Table 3-4. Content Delivery Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Content Publishing and Delivery – defines the set of capabilities that allow for the propagation of interactive programs.	Digital Assets Services	Content Management
Information Sharing – defines the set of capabilities that support the use of documents and data in a multi-user environment for use by an organization and its stakeholders.	Digital Assets Services	Knowledge Management
Knowledge Distribution and Delivery - defines the set of capabilities that support the transfer of knowledge to the end customer.	Digital Assets Services	Knowledge Management

3.2.2 Enabling Technology Services

Enabling technology services are those components that support the delivery of specific NBII Framework functions. The seven enabling technology services of the NBII include:

1. Intelligent Agents and Search Services
2. Standards and Taxonomy
3. Information Management

4. Collaboration, Communities and Personalization
5. System Development
6. Geospatial Services and Development
7. Program Management Functions

The figure below illustrates the relationship between the seven enabling technologies and the service components referenced in the FEA SRM.

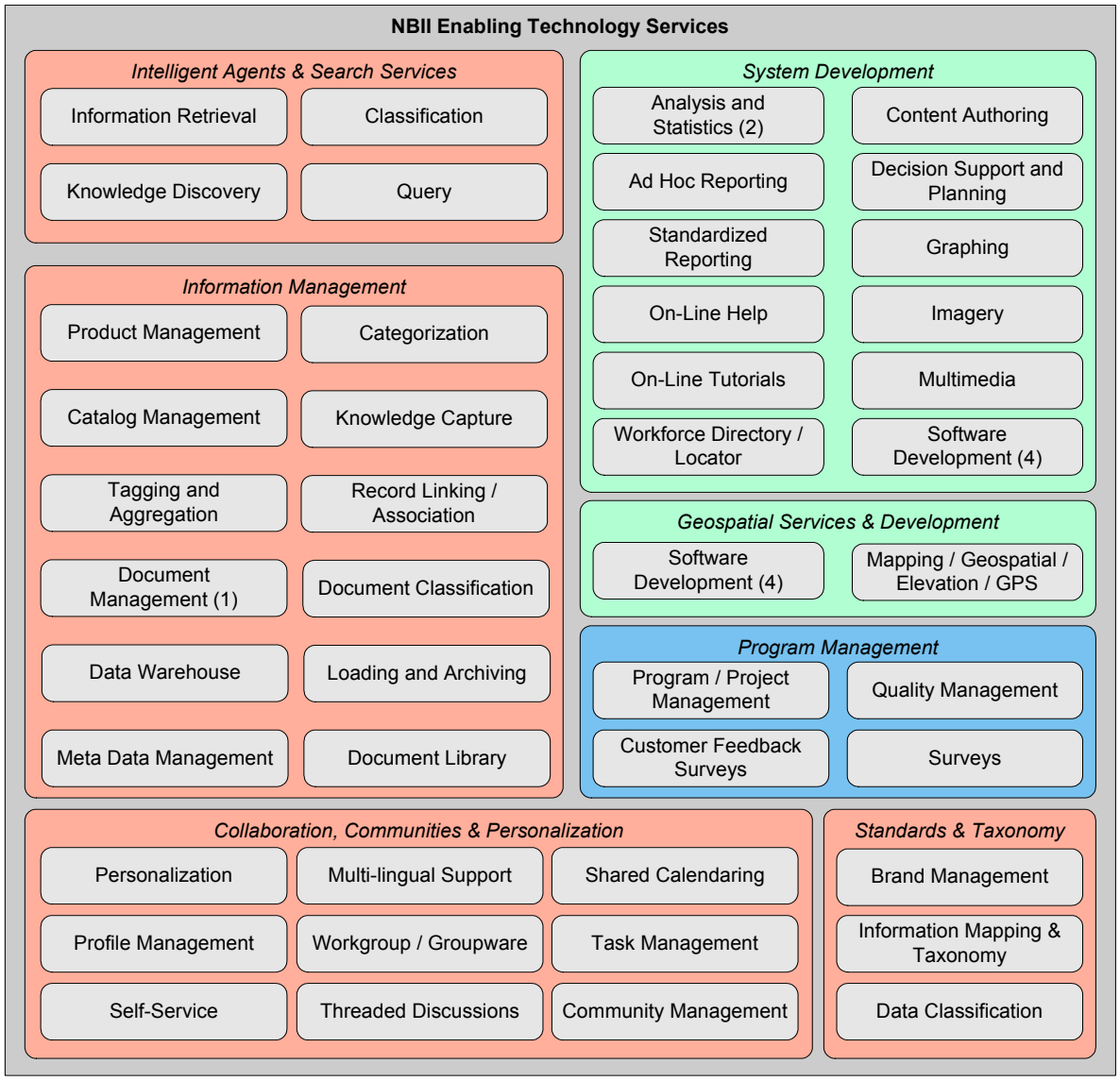

Figure 3-3. NBII Enabling Technology Services Logical Model

NOTES:

(1) Document Management - includes Document Referencing, Library / Storage, Document Conversion, Indexing, Classification service components

(2) Analysis and Statistics - includes Modeling, Predictive, Simulation, Mathematical, and Structural / Thermal service components

(3) Software Development service component is shared between the System Development and Geospatial Services & Development functions of the Technology Management services layer of the NBII Enterprise Framework

(4) Program Management includes the Planning and Resource Allocation, Relationship Management, and Quality Assurance and Training functions.

3.2.2.1 Intelligent Agents and Search Services

The NBII provides access to its information through the use of intelligent agents and search services. An intelligent agent is a program that gathers information or performs some other service without the immediate presence of the information consumer using push technology. Search services, a fundamental function provided by the NBII, provides biological information consumers the capability to query multiple, distributed data sources from a single user interface. The intelligent agents and search services support the distribution and sharing of NBII data and content with biological information consumers.

The agents and search function provide biological information consumers with the ability to lookup of specific data from a data source and provides the capabilities that support the identification and gathering of meaning documents, reports and other sources. The following table lists the service components, as defined by the FEA SRM, which are an integral part of the NBII agent and search processes.

Table 3-5. Intelligent Agents and Search Services Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Information Retrieval – defines the set of capabilities that allow access to data and information for use by an organization and its stakeholders.	Digital Assets Services	Knowledge Management
Knowledge Discovery - defines the set of capabilities that facilitate the identification of useful information from data.	Digital Assets Services	Knowledge Management
Query – defines the set of capabilities that support retrieval of records that satisfy specific query selection criteria.	Support Services	Search
Classification – defines the set of capabilities that support selection and retrieval of records organized by shared characteristics in content or context.	Support Services	Search

3.2.2.2 Standards and Taxonomy

The underlying foundation of the NBII is the established standards and taxonomy that support the consistent application of NBII business rules, enable effective and efficient exchange of information, facilitate the discovery of information, and significantly enhance information management. The NBII Program supports the ongoing development, distribution, and usage of standards and taxonomy including the FGDC metadata standard with biological data profile extension, taxonomic nomenclature and standards (e.g., Integrated Taxonomic Information

System – IT IS), geospatial standards (e.g., OpenGIS), content management standards, Dublin Core standards, and website standards. The standards help the NBII to manage activities with its biological information consumers. Additionally, standards and taxonomy to name, describe, and classify information support the generation of intellectual capital that is sharable across NBII participants and complementary initiatives.

The standards and taxonomy function is critical to the development of capabilities that support the identification and gathering of biological information as well as capabilities that support the usage, processing and general administration of that information. The following table lists the service components, as defined by the FEA SRM, which are supported by the NBII standards and taxonomy function.

Table 3-6. Standards and Vocabulary Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Brand Management – defines the set of capabilities that support the application of a trade name to a product or service as well as developing awareness for the name.	Customer Services	Customer Relationship Management
Information Mapping / Taxonomy – defines the set of capabilities that support the creation and maintenance of relationships between data entities, naming standards, and categorization.	Digital Assets Services	Knowledge Management
Data Classification – defines the set of capabilities that allow the classification of data.	Back Office Services	Data Management

3.2.2.3 Information Management

The NBII Program collects, compiles, stores, and manages biological content from numerous sources. This data is stored and presented in a variety of formats, including XML, PDF, SGML, HTML, and SQL. The NBII's Information Management services includes the capabilities that control the processes for collection, compiling, tagging, aggregating, cataloging, storage, dissemination, and management of NBII biological data and information. These services ensure that information is available to biological information consumers and improves the quality of the services provided by the NBII Program.

The Information Management function is critical to the mission of the NBII. It includes the capabilities that control the capture and maintenance of the NBII's documents and files. Additionally, is supports the transformation, usage, and processing of data into meaningful information. The Information Management function also provides the capabilities required to support the storage, protection, archiving, classification, and retirement of documents and information. The following table lists the service components, as defined by the FEA SRM, encapsulated within various business component systems that help support information management across the NBII.

Table 3-7. Information Management Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Product Management – defines the set of capabilities that facilitate the creation and maintenance of products and services.	Customer Services	Customer Relationship Management
Catalog Management – defines the set of capabilities that support the listing of available products or services that an organization offers.	Business Management Services	Supply Chain Management
Tagging and Aggregation – defines the set of capabilities that support the identification of specific content within a larger set of content for collection and summarization.	Digital Assets Services	Content Management
Document Referencing – defines the set of capabilities that support the redirection to other documents and information for related content.	Digital Assets Services	Document Management
Document Conversion – defines the set of capabilities that support the changing of files from one type of format to another.	Digital Assets Services	Document Management
Library / Storage – defines the set of capabilities that support document and data warehousing and archiving.	Digital Assets Services	Document Management
Indexing – defines the set of capabilities that support the rapid retrieval of documents through a structured numbering construct.	Digital Assets Services	Document Management
Classification – defines the set of capabilities that support the categorization of documents.	Digital Assets Services	Document Management
Categorization – defines the set of capabilities that allow classification of data and information into specific layers or types to support an organization.	Digital Assets Services	Knowledge Management
Knowledge Capture – defines the set of capabilities that facilitate collection of data and information.	Digital Assets Services	Knowledge Management
Record Linking / Association - defines the set of capabilities that support the correlation between logical data and information sets.	Digital Assets Services	Records Management
Document Classification – defines the set of capabilities that support the categorization of documents and artifacts, both electronic and physical.	Digital Assets Services	Records Management
Data Warehouse – defines the set of capabilities that support the archiving and storage of large volumes of data.	Back Office Services	Data Management
Meta Data Management – defines the set of capabilities that support the maintenance and administration of data that describes data.	Back Office Services	Data Management
Loading and Archiving – defines the set of capabilities that support the population of a data source with external data.	Back Office Services	Data Management
Document Library – defines the set of capabilities that support the grouping and archiving of files and records on a server.	Support Services	Collaboration

3.2.2.4 Collaboration, Communities, and Personalization

The NBII Portal provides biological information consumers and contributors with the ability drive initiatives, exchange information, and interact with other resources integrated into the portal. Additionally, the NBII Portal can be individually personalized to provide the required

interface and to deliver applications and workspaces specific to the needs of an individual or defined group. The NBII Portal allows biological information consumers and contributors to collaborate, working together as a defined community on projects to set schedules, assign tasks, share documents, participate in threaded discussions, and exchange ideas. Each community can effectively function as a separate site within the NBII Portal, each with its own security, branding, and functionality.

The collaboration, communities, and personalization function of the NBII provides a set of capabilities that:

- Allows biological information contributors and consumers personalize the NBII portal without direct assistance from the NBII Program.
- Support both collaboration and communication within an organization.
- Allows for the concurrent, simultaneous communication and sharing of content, schedules, messages, and ideas across the NBII.

The following table lists the service components, as defined by the FEA SRM, encapsulated within the NBII Portal that help support collaboration, communities, and personalization across the NBII.

Table 3-8. Collaboration, Communities, and Personalization Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Personalization – defines the set of capabilities to change a user interface and to control how data is displayed.	Customer Services	Customer Preferences
Profile Management – defines the set of capabilities that allow for the maintenance and modification of a customer's account information related to their profile.	Customer Services	Customer Preferences
Self–Service – defines the set of capabilities that allow an organization's customers to sign up for a particular service at their own initiative.	Customer Services	Customer Initiated Assistance
Multi–lingual Support – defines the set of capabilities that allow access to data and information in multiple languages.	Customer Services	Customer Initiated Assistance
Workgroup/Groupware - defines the set of capabilities that support multiple users working on related tasks.	Business Management Services	Organizational Management
Threaded Discussions – defines the set of capabilities that support the running log of remarks and opinions about a given topic or subject.	Support Services	Collaboration
Shared Calendaring – defines the set of capabilities that allow an entire team as well as individuals to view, add, and modify each other's schedules, meetings, and activities.	Support Services	Collaboration
Task Management – defines the set of capabilities that support a specific undertaking or function assigned to an employee.	Support Services	Collaboration
Community Management - defines the set of capabilities that support the administration of online groups that share common interests.	Support Services	Communication

3.2.2.5 System Development

In addition to helping to increase access to biological data and information from different sources, the NBII is working with others to increase access to software tools that can be used to collect, manage, document, analyze, and apply biological data. NBII's system development activities support a variety of NBII functions by providing tools that help the biological information consumers interact with the NBII. These tools include the creation of content, the conversion of content to meaningful and transferable formats, data visualization capabilities, and the examination of the content to prepare meaningful analyses and reports. The following table lists the service components, as defined by the FEA SRM, for which tools have been developed that provide support across multiple NBII functions.

Table 3-9. System Development Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Online Help – defines the set of capabilities that provide an electronic interface to customer assistance.	Customer Services	Customer Initiated Assistance
Online Tutorials – defines the set of capabilities that provide an electronic interface to educate and assist customers.	Customer Services	Customer Initiated Assistance
Content Authoring – defines the capabilities that allow for the creation of tutorials, CBT courseware, Web sites, CD-ROMs, and other interactive programs.	Digital Assets Services	Content Management
Analysis and Statistics • Modeling – defines the set of capabilities that support the simulating of conditions or activities by performing a set of equations on a set of data. • Predictive – defines the set of capabilities that support the foretelling of something in advance by the use of data. • Simulation – defines the set of capabilities that support the representation of the interaction between real-world objects. • Mathematical – defines the set of capabilities that support the use of mathematical functions and algorithms for the analysis of data. • Structural / Thermal – defines the set of capabilities that support the use of data flow and data modeling diagrams for applying systematic analysis of data.	Business Analytical Services	Analysis and Statistics
Graphing / Charting – defines the set of capabilities that support the presentation of information in the form of diagrams or tables.	Business Analytical Services	Visualization
Imagery – defines the set of capabilities that support the creation of film or electronic images from pictures, paper forms, or graphics for static or dynamic use.	Business Analytical Services	Visualization
Multimedia – defines the set of capabilities that support the representation of information in more than one form to include text, audio, graphics, animated graphics and full motion video.	Business Analytical Services	Visualization
Decision Support and Planning – defines the set of capabilities that support the analyze information and predict the impact of decisions before they are made.	Business Analytical Services	Business Intelligence

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Reporting • Ad Hoc – defines the set of capabilities that support the use of dynamic reports on an as needed basis. • Standardized / Canned – defines the set of capabilities that support the use of preconceived or pre-written reports.	Business Analytical Services	Reporting
Workforce Directory / Locator – defines the set of capabilities that support the listing of employees and their whereabouts.	Back Office Services	Human Capital / Workforce
Software Development – defines the set of capabilities that support the creation of both graphical and process application and system software.	Back Office Services	Development and Integration

Note: The software development service component is shared by the System Development and Geospatial Services & Development functions of the Technology Management services layer of the NBII Enterprise Framework.

3.2.2.6 Geospatial Services and Development

The NBII has adopted and implemented the Open Geospatial Information Standards (OGIS). By applying these standards, NBII's is able to develop geospatial tools. These tools will extend NBII's capabilities to provide geography as key criteria for the extraction, aggregation, and presentation of spatially relevant data into graphical or picture form. Geospatial development based on the OGIS will support the sharing, integration, and deployment of NBII developed tools. The NBII has also developed in-house geospatial guidelines and standards, which address standard buttons, look and feel, features, etc. and to insure consistent and usable web-mapping applications are developed throughout the NBII network. The following table lists the service components, as defined by the FEA SRM, which are an integral part of the geospatial services provided by the NBII.

Table 3-10. Geospatial Services and Development Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Mapping / Geospatial / Elevation / GPS – defines the set of capabilities that support the use of elevation, latitude, and longitude coordinates.	Business Analytical Services	Visualization
Software Development – defines the set of capabilities that support the creation of both graphical and process application and system software.	Back Office Services	Development and Integration

Note: The software development service component is shared by the System Development and Geospatial Services & Development functions of the Technology Management services layer of the NBII Enterprise Framework.

3.2.2.7 Program Management

The NBII Program provides technical leadership, management, and strategic direction for the NBII and its investments. Effective program management is accomplished through various integrated processes designed to support the initiation, planning, execution, control, and closeout of NBII projects. Program Management provides the set of capabilities that support the

management and execution of all NBII functions and activities that provide continuity across the NBII.

Program Management functions support NBII's ability to plan, schedule, and control activities between the NBII and biological information contributors, to assess the quality of interactions between the NBII and biological information consumers, and to regulate NBII activities. The following table lists the service components, as defined by the FEA SRM, which are an integral part of the program management services provided by the NBII.

Table 3-11. Program Management Components

SRM COMPONENT	SRM DOMAIN	SRM SERVICE TYPE
Customer Feedback – defines the set of capabilities that are used to collect, analyze and handle comments and feedback from an organization's customers.	Customer Services	Customer Relationship Management
Surveys – defines the set of capabilities that are used to collect useful information from an organization's customers.	Customer Services	Customer Relationship Management
Program / Project Management – defines the set of capabilities for the management and control of a particular effort of an organization.	Business Management Services	Management of Process
Quality Management - defines the set of capabilities intended to help determine the level of assurance that a product or service will satisfy certain requirements.	Business Management Services	Management of Process
Risk Management – defines the set of capabilities that support the identification and probabilities or chances of hazards as they relate to a task, decision, or long-term goal.	Business Management Services	Management of Process

3.3 NBII Technology Framework

The NBII Technology Framework describes the current technology framework that delivers NBII's core and enabling technology services. The technology framework includes three distinctive network layers, including:

1. Outside World – the mechanisms by which biological information consumers and contributors access the NBII via a public network.
2. Demilitarized Zone (DMZ) - a small network inserted as a "neutral zone" between the NBII private network (internal environment) and the outside public network. The DMZ prevents outside users from getting direct access to servers that house NBII or agency data, internal systems, and/or sensitive information.
3. Internal Environment – the private NBII network within agency boundaries.

NBII's core and enabling technology are supported by the standards, specifications, and technologies represented within four service areas, as defined by the FEA TRM, that span the NBII technology framework.

1. Service Access and Delivery – standards and specifications supporting external access, exchange, and delivery of NBII services
2. Service Platform and Infrastructure – delivery and support platforms, infrastructure capabilities, and hardware upon which the NBII is constructed.
3. Component Framework – underlying foundation, technologies, standards, and specifications that support the construction, exchange, and deployment of NBII services across the NBII technology framework.
4. Service Interface and Integration – collection of technologies, methodologies, standards, and specifications that govern the interface, both internally and externally, with NBII services.

The figure below illustrates the scope of NBII core and enabling technologies services across the network framework:

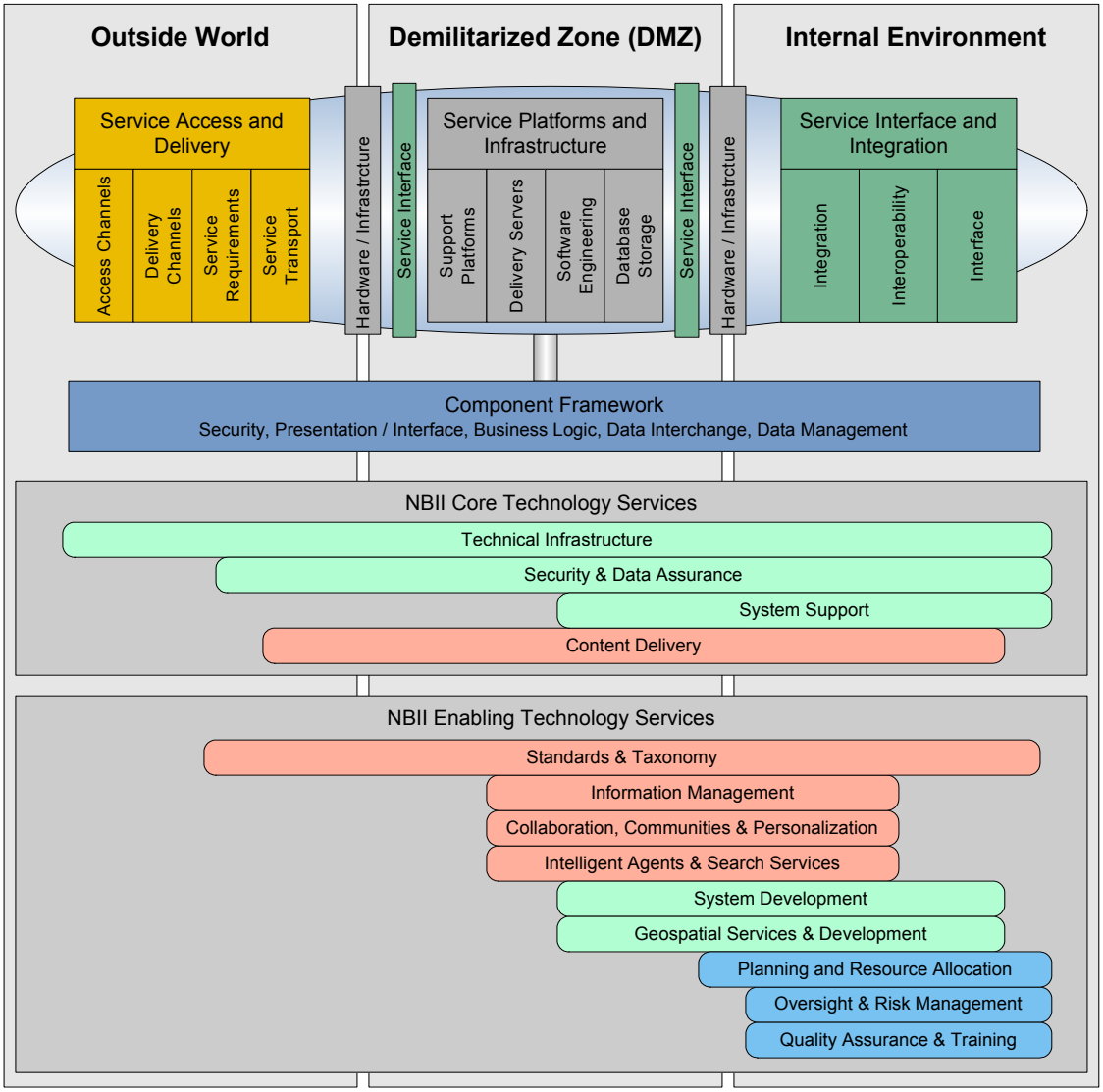

Figure 3-4. NBII Technology Framework

3.3.1 Service Access and Delivery

The Service Access and Delivery service area includes the access and delivery channels that provide the entry point to the NBII from the outside world. These channels are supported by network services that provide for information transport between the NBII and biological information consumers and contributors. Additionally, the access channels are governed by specific legislative requirements that govern the use of and interaction with the NBII. These standards, delivered via the Technical Infrastructure and the Security and Data Assurance functions, support:

- Section 508 Compliance – Section 508 requires that Federal agencies' electronic and information technology is accessible to people with disabilities, including employees and members of the public.
- Web Content Accessibility - Refers to hardware and software that helps people who are physically or visually impaired.
- Security - Policy and procedures that protect data against unauthorized access, use, disclosure, disruption, modification, or destruction.
- Privacy - Policy that deals with the degree to which an individual can determine which personal information is to be shared with whom and for what purpose.
- Website Hosting – The NBII hosts both its own website (www.nbii.gov) as well as the websites of several of NBII Information Nodes. NBII Information Nodes support the delivery of biological information and resources within a defined theme or geographic region through partnering with organizations to provide biological information content to NBII consumers.

The Technical Infrastructure function delivers the service transport capability for the NBII. This capability provides for the end-to-end management from access to the NBII through delivery of requested information. The Content Delivery function is supported by the use of a set of protocols that define the format and structure of data and information that is either accessed by a biological information consumer or exchanged by a biological information contributor.

3.3.2 Service Platform and Infrastructure

The NBII, through the Center for Biological Informatics (CBI), provides interoperability, availability, and consistency of resources, managing and implementing the core service platforms and infrastructure that deliver the primary services of the NBII. The Technical Infrastructure function is the technical core of the NBII. It provides the delivery and support platforms, infrastructure capabilities, and hardware upon which the NBII is constructed. This includes

- The supporting hardware platforms and software the represents the core NBII infrastructure.
- The front-end platforms that deliver information to respond to a user request.

- The physical devices, facilities, and standards that provide the computing and networking within and between the outside world, the NBII DMZ, and the NBII internal environment.
- The collection of programs that enable storage, modification, and extraction of biological information from the NBII metadata clearinghouse and other data stores
- The software engineering that covers not only the development aspects of NBII software systems but also the technical support and management of those systems.

The Technical Infrastructure function supports the delivery of NBII services across the NBII technical framework. The compiling, aggregating, and storing biological data and information requires the integration of delivery servers, software systems, and data storage components. This information is made available through components that provide for the transformation, storage, and delivery of NBII content; support the development of collaborative communities, delivery requested information via personalized views; and support the querying and location of specific biological information across the NBII network of biological information contributors.

3.3.3 Component Framework

The Component Framework includes the technologies, standards, and specifications that support the construction, exchange, deployment, and delivery of NBII services across the NBII technology framework. The NBII is structured as a group of components that together make up the functionality delivered by each NBII service. Each of these components provides a particular function or group of related functions. The technologies, standards, and specifications used to develop NBII components include:

- Security - the methods of protecting NBII information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction.
- Presentation / Interface - the visual and physical representation of the connection between the biological information consumer and contributor and the NBII.
- Business Logic - the software, protocol, or method in which business rules are enforced within the NBII.
- Data Interchange - the methods by which data is transferred into the NBII, represented within the NBII, and exchanged between the NBII and users.
- Data Management – the management of all data/information of the NBII, including data administration, the standards for defining data, and the way in which NBII data will be accessed and used.

3.3.4 Service Interface and Integration

At a simplified level, the NBII is a framework that connects biological information consumers with biological information contributors and provides a means for interacting with complementary initiatives. The NBII supports the effective and efficient exchange of the Nation's biological information and data resources to consumers of biological information. The key to linking biological information consumers with the information generated by biological information contributors and served through the NBII is service integration, interoperability, and

interface. Specifically, the collection of technologies, methodologies, standards, and specifications that govern the interaction, both internally and externally, with NBII services.

Integration enables the enables elements of the NBII to interoperate. These elements can share function, content, and communications across the NBII technical framework. Through the use of standards, middleware, and tools, the NBII provides access to and across multiple database technologies. This integration drives the interoperability that supports the discovery and sharing NBII data and services between biological information consumers and contributors. NBII biological information is stored in a number of data formats. The NBII supports the integration of this information through the use of standard data specifications. Data standards followed by the NBII support the transformation of information for presentation via a graphical user interface and for analysis using biological and geospatial applications.

3.4 NBII Technical Reference Model

The NBII Technical Reference Model identifies the standards and technologies that support the delivery of NBII's services across the technical framework. This reference model, illustrated in the figure below, depicts the baseline or "as is" design architecture of the NBII.

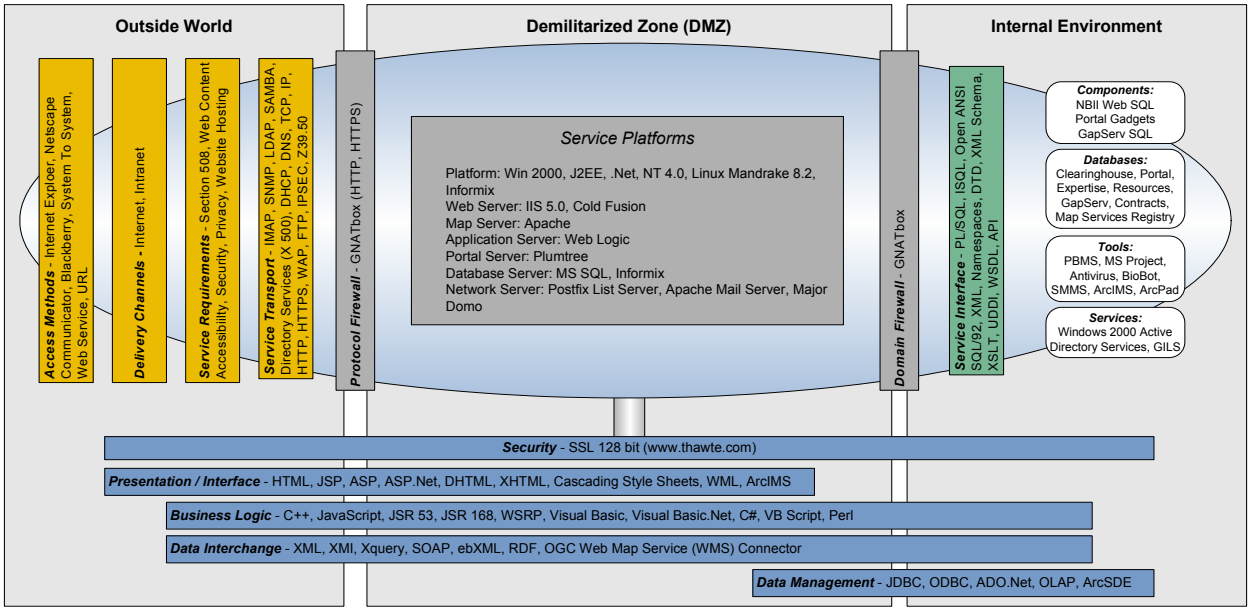

Figure 3-5. NBII Technical Reference Model

The following sections identify the technology components as described by the FEA TRM that support the NBII technical framework. The information is organized by the four core services areas. Within each service area are tables that list the service standards and specifications deployed within each service category.

3.4.1 Service Access and Delivery

The Service Access and Delivery service area, as defined by the FEA TRM, includes the following categories:

- Access Channels
- Delivery Channels
- Service Requirements
- Service Transport

Access Channels provide the interface between the NBII and its users. The following table identifies the hardware, software, or specifications used by the NBII that are included in the Access Channels service category.

Table 3-12. Access Channels

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Web Browser	Internet Explorer - Microsoft Internet Explorer (MSIE) is the most widely used World Wide Web browser.	NBII fully supports version 5.0 and greater.
Web Browser	Netscape Communicator - Netscape is the second most widely used World Wide Web browser.	NBII fully supports version 4.7 and 7.x
Wireless / PDA	Blackberry - The leading email enabled wireless device with wide use in several Agencies.	USGS users can access both DMZ and NBII internal services.
Other Electronic Channels	System To System - System to System involves at least two computers that exchange data or interact with each other independent of human intervention or participation.	This component supports the exchange of data between the NBII and the clearinghouse service provider.
Other Electronic Channels	Web Service - Web services (sometimes called application services) are services (usually including some combination of programming and data, but possibly human data as well.	Made available from the NBII's web server for Web users or other Web-connected programs.
Other Electronic Channels	URL - Uniform Resource Locator (URL) is the global address of documents and other resources on the World Wide Web. The first part of the address indicates what protocol to use (i.e. "http://"), and the second part specifies the IP address or the domain name where the resource is located.	http://www.nbii.gov http://my.nbii.gov http://mercury.ornl.gov/nbii/ Websites of NBII Information Nodes

Delivery channels provide the access to NBII applications and systems based upon the type of network used to deliver them. The following table identifies the delivery channels used by the NBII that are included in the Delivery Channels service category.

Table 3-13. Delivery Channels

SERVICE STANDARD	NBII SPECIFICS
Internet - The Internet is a worldwide system of computer networks in which users at any one computer can obtain information from any other computer.	To access NBII URL's.
Intranet - a private network that is contained within an enterprise used to share company information and resources among employees.	To access data internal to USGS.

The NBII is subject to certain legislative, performance, and hosting requirements. The following table identifies the specifications used by the NBII that are included in the Service Requirements service category.

Table 3-14. Service Requirements

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Legislative / Compliance	Section 508 – Section 508 requires that Federal agencies' electronic and information technology is accessible to people with disabilities, including employees and members of the public.	NBII complies with Section 508 and manages compliance through web design standards and website audits.
Legislative / Compliance	Web Content Accessibility - Refers to hardware and software that helps people who are physically or visually impaired.	NBII supports website accessibility through web design standards and website audits.
Legislative / Compliance	Security - Policy and procedures that protect data against unauthorized access, use, disclosure, disruption, modification, or destruction.	NBII security exists at both the firewall (i.e., DMZ and internal) and system (e.g., portal) level.
Legislative / Compliance	Privacy - Policy that deals with the degree to which an individual can determine which personal information is to be shared with whom and for what purpose.	NBII follows a privacy policy that is accessible via the NBII website, portal, and Information Node websites.
Hosting	Internal (within Agency) – The hosting of a web site or application within an Agency. The Agency is responsible for the maintenance, support, and availability of the web site or application.	The NBII hosts both its own website (www.nbii.gov) as well as the websites of several of NBII Information Nodes.

The NBII uses access and delivery protocols to provide end-to-end management of communications session. Specifically, the NBII uses protocols that define the format and structure of data and information accessed via the NBII website or portal. The following table identifies the hardware, software, or specifications used by the NBII that are included in the Service Transport service category.

Table 3-15. Service Transport

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Supporting Network Services	IMAP (Internet Message Access Protocol (RFC2060) V4.1) / POP3 (Post Office Protocol) – IMAP4rev1 allows a client to access and manipulate electronic mail messages on a server. IMAP4rev1 permits manipulation of remote message folders, called "mailboxes," in a way that is functionally equivalent to local mailboxes. IMAP4rev1 also provides the capability for an offline client to resynchronize with the server. POP3 is the most commonly used protocol for retrieving e-mail from a mail host.	The NBII is developing an IMAP portlet for the portal that will provide access to any IMAP-compliant messaging server to support remote and mobile access to e-mail by USGS users.
Supporting Network Services	SNMP V3 (Simple Network Management Protocol) - SNMP Eliminates several of the security vulnerabilities in earlier version.	Protocol governing NBII network management and the monitoring of network devices and their functions. The portal integrates with SNMP on UNIX to provide read-outs of components' performance characteristics.
Supporting Network Services	LDAP V3 (RFC 1779) (Lightweight Directory Access Protocol) - LDAP is a subset of X.500 designed to run directly over the TCP/IP stack. LDAP is, like X.500, both an information model and a protocol for querying and manipulating it. LDAPv3 is an update developed in the IETF (Internet Engineering Task Force), which address the limitations found during deployment of the previous version of LDAP.	LDAP protocol is used to locate resources such as files and devices in the network, whether on the public Internet or on a USGS intranet. Future ability to provide single sign-on will be supported by Authentication Web Services allowing the portal to authenticate users and groups from numerous domains, networks, and servers. The service will use LDAP to synchronize disparate group and user directories. The use of LDAP is already in place for the prototype “My NBII” future portal to aid in USGS user authentication.
Supporting Network Services	Directory Services (X.500) – This is a network service that discovers and identifies resources on a network and makes them accessible to users and applications. The resources include users, e-mail addresses, computers, mapped drives, shared folders, and peripherals such as printers and PDA docking stations. Users and computers access these resources without the needing to know how or where the resources are connected.	NDS (Novell Directory Services) is used to manage access to computer resources and keeping track of the users of a network, such as a company's intranet, from a single point of administration for Local Area Network related NBII resources.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Supporting Network Services	DHCP (Dynamic Host Configuration Protocol) – A protocol for assigning dynamic IP addresses to devices on a network. A device can receive a different IP address for every connection. Dynamic addressing provides reduced network administration over deploying and connecting user and peripheral devices.	NBII uses DHCP to support Local Area Network (LAN) functions within remote NBII network offices.
Supporting Network Services	DNS (Domain Name System) – A protocol used for translating domain names (i.e. www.feapmo.gov) to their respective IP addresses. DNS is collectively a network of devices that store query results. As one DNS server or device cannot provide the translated IP address, it queries other DNS devices. This process is invisible to the user.	The domain name system (DNS) used to locate NBII domain names and translate them into Internet Protocol addresses, and vice versa. This support for core NBII servers is provided by USGS and NBII maintains DNS capabilities to support off-site mirroring of systems.
Supporting Network Services	SAMBA - Samba is a popular freeware program that allows end users to access and use files, printers, and other commonly shared resources on a company's intranet or on the Internet. Samba is often referred to as a Network File System and can be installed on a variety of operating system platforms, including: Linux, most common Unix platforms, OpenVMS, and OS/2.	NBII uses SAMBA on its Linux servers to support data storage and backup.
Service Transport	TCP (Transport Control Protocol) - TCP provides transport functions, which ensures that the total amount of bytes sent is received correctly at the destination.	When an HTML file is accessed by an NBII user from an NBII website, TCP program layer in the NBII web server divides the file into one or more packets and then forwards them individually to the IP program layer. At the other end a client program on the user's computer uses TCP to reassemble the individual packets and display them as a single file. When publishing content on the NBII portal, content is sent via XML using the Transmission Control Protocol (TCP) to index the content to support search functions. Server metadata in Plumtree Search.
Service Transport	IP (Internet Protocol) - This is the protocol of the Internet and has become the global standard for communications. IP accepts packets from TCP, adds its own header, and delivers a "datagram" to the data link layer protocol. It may also break the packet into fragments to support the maximum transmission unit (MTU) of the network.	Method or protocol used by NBII to send from one computer to another on the Internet.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Service Transport	HTTP (Hyper Text Transfer Protocol) - The communications protocol used to connect to servers on the World Wide Web. Its primary function is to establish a connection with a web server and transmit HTML pages to the client browser.	Used by the NBII information served over the world wide web. The Portal includes an HTTP library that supports opening connections to a large number of Web services virtually simultaneously, supporting portal web crawler services and a scalable Web services-based architecture.
Service Transport	HTTPS (Hyper Text Transfer Protocol Secure) - The protocol for accessing a secure Web server. Using HTTPS in the URL instead of HTTP directs the message to a secure port number rather than the default Web port number of 80. The session is then managed by a security protocol.	NBII uses HTTPS to encrypt and decrypt applicable user username/password page requests as well as the pages that are returned by the Web server. HTTPS and SSL together support the use of X.509 digital certificates from the server so that, when applicable, NBII can authenticate the sender. The NBII will be able to integrate resources from various systems within the USGS into the portal as Web services by utilizing HTTPS, enabling the USGS to use the Web as a common platform.
Service Transport	WAP (Wireless Application Protocol) - The Wireless Application Protocol (WAP) is an open, global specification that empowers users of digital mobile phones, pagers, personal digital assistants and other wireless devices to securely access and interact with Internet/intranet/extranet content, applications, and services.	The NBII relies on WAP specification to standardize the way wireless devices, such as cellular telephones, blackberries, IPAQ, Palm, and radio transceivers, are used to access the NBII website. The portal will support the future access of NBII portal resources from virtually anywhere through the use of a wireless device.
Service Transport	FTP (File Transfer Protocol) - A protocol used to transfer files over a TCP/IP network (Internet, UNIX, etc.). For example, after developing the HTML pages for a Web site on a local machine, they are typically uploaded to the Web server using FTP.	In some situations, the NBII uses FTP (e.g., proFTPD, a highly configurable GPL-licensed FTP server software) to transfer files containing biological content. Portal content can be published to web pages via FTP or local area network connections.
Service Transport	IPSEC (IP Security) – A set of protocols used to secure IP packet exchange. Tunnel and Transport are the two (2) modes supported by IPSEC. IPSEC uses certificates and Public Keys to authenticate and validate the sender and receiver.	IPSEC is a framework for a set of protocols that supports NBII security at the network or packet processing layer of network communication.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Service Transport	Z39.50 – standard communications protocol for the search and retrieval of bibliographic data in online databases.	NBII uses Z39.50 to retrieve application service definitions in support of delivering metadata and datasets via the NBII Metadata Clearinghouse.

Note: SAMBA and Z39.50 are not referenced in the FEA TRM.

3.4.2 Service Platform and Infrastructure

The Service Platform and Infrastructure service area, as defined by the FEA TRM, includes the following categories:

- Supporting Platforms
- Delivery Servers
- Software Engineering
- Database / Storage
- Hardware / Infrastructure

A platform is the underlying computer system on which application programs, like the NBII, are run. NBII applications run on various platforms that consist of an operating system, the computer system's coordinating program, and the hardware that performs logic operations and manages data movement in the computer. The following table identifies the hardware, software, or specifications that support the Supporting Platforms service category.

<I think this section is poorly organized in the FEA TRM. IT does not seem to accommodate other platforms, such as Linux. Your thoughts with regard to NBII specifics?>

Table 3-16. Supporting Platforms

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Platform Independent (J2EE) J2EE (Java 2 Platform Enterprise Edition)	Sun's J2EE and Microsoft's .Net are the two dominant distributed computing architecture frameworks. J2EE provides portability of a single language (Java) over multiple operating systems and hardware platforms.	WebLogic server is based on Java 2 Platform, Enterprise Edition (J2EE), the standard platform used to create Java J2EE multi-tier enterprise applications. Additionally, NBII uses Apache Tomcat for the J2EE application server and anticipates that this server will run future versions of the NBII portal.
Platform Dependent (J2EE) Windows 2000	Also known as "Win2K" and "W2K," it is a major upgrade to Windows NT 4. Launched in February 2000, Windows 2000 comes in one client and three server versions. Windows 2000 looks like Windows 95/98, but adds considerably more features, dialogs, and options.	NBII uses Windows 2000 on various servers including database server, primary domain controller, web and ASP server, and application server. Additionally, NBII uses NT4.0 to support the backup domain controller and print server.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Platform Dependent (J2EE) Windows.Net	Microsoft's .Net and Sun's J2EE are the two dominant distributed computing architecture frameworks. .Net supports a wide range of languages but is primarily tied to the Microsoft Windows operating system and Intel hardware.	The .net platform supports portal and resource catalog development. Future versions of the NBII portal will be deployed on this platform.

The delivery servers provide the services that support the NBII website, portal, and applications. The following table identifies the hardware, software, or specifications used by the NBII that are included in the Delivery Servers service category.

Table 3-17. Delivery Servers

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Web Servers	Apache – A widely-used public domain, UNIX-based Web server from the Apache Group (www.apache.org). It is based on, and is a plug-in replacement for, NCSA's HTTPd server Version 1.3. The name came from a body of existing code and many "patch files."	Apache is used to by NBII to provide map data and GapServ information.
Web Servers	Internet Information Server – Web server software from Microsoft that runs under Windows NT, Windows 2000, and Microsoft.Net. It supports Netscape's SSL security protocol and turns an NT-based PC into a Web site. Microsoft's Web browser, Internet Explorer, is also included.	The NBII web server uses a client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP), to serve the files that form the NBII website. Additionally, web servers host the "gadgets" that provide specific functionality in support of the NBII portal.
Application Servers	Various	The NBII uses a variety of application servers including WebLogic, Tomcat, and .net. The WebLogic and Tomcat application servers support J2EE platforms while the .net runs on a Windows platform.
Portal Servers	No specifications provided in the FEA TRM.	The NBII portal is a single gateway to a NBII's biological information for biological information consumer. The NBII portal runs on traditional J2EE application servers and Microsoft Windows. Plumtree Portal collaboration server runs on a BEA WebLogic server.

The following table identifies the hardware, software, or specifications used by the NBII that are included in the Software Engineering service category.

Table 3-18. Software Engineering

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Integrated Development Environment (IDE)	Visual Studio.NET – A comprehensive tool set for rapidly building and integrating XML Web services, Microsoft Windows–based applications, and Web solutions. This is the successor to Visual Studio.	The NBII Web Resources, Dublin Core based, Catalog Tool was written and developed in Visual Studio.NET. Portal web services capabilities are being deployed via Visual Studio.NET.

The NBII uses a collection of programs that enable storage, modification, and extraction of biological information from its databases and various devices for backup and archival of large amounts of data. The following table identifies the hardware, software, or specifications used by the NBII that are included in the Database / Storage service category.

Table 3-19. Database / Storage

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Database	Oracle – Relational database product; the first to support the SQL language.	Select NBII Nodes store data in Oracle.
Database	SQL Server – Data management server product developed by Microsoft.	NBII stores data in MS SQL in the private network. Select NBII nodes store data in MS SQL.
Database	Informix - IBM data management software for data warehousing, analysis and reporting, Web content delivery, and broadcasting from a digital media library.	NBII stores data in the DMZ in Informix. Select NBII nodes store data in Informix.
Storage	SAN (Storage Area Network) – A SAN is a high-speed sub-network of shared storage devices. A storage device is a machine that contains nothing but a disk or disks for storing data.	NBII uses a CD server to support backup and archiving activities.

Note: Informix is not listed in the FEA TRM.

The NBII uses various physical devices, facilities, and standards to support its computing and networking services. The following table identifies the hardware used by the NBII that are included in the Hardware / Infrastructure service category.

Table 3-20. Hardware / Infrastructure

SERVICE STANDARD	SERVICE SPECIFICATION
Servers / Computers	Enterprise Server – A computer or device on a network that manages network resources and shared applications for multiple users.
Embedded Technology Devices	RAM (Random Access Memory) – A type of computer memory that can be accessed randomly (e.g., any byte of memory can be accessed without touching the preceding bytes). RAM is the most common type of memory found in computers and other devices, such as printers.

SERVICE STANDARD	SERVICE SPECIFICATION
Embedded Technology Devices	Hard Disk Drive – Refers to the area of a computer that where data is stored.
Embedded Technology Devices	Microprocessor - A silicon chip that contains a CPU. In the world of personal computers, the terms microprocessor and CPU are used interchangeably. At the heart of all personal computers and most workstations sits a microprocessor.
Embedded Technology Devices	Redundant Array of Independent Disks (RAID) – An assembly of disk drives that employ two or more drives in combination for fault tolerance and performance. RAID disk drives are used frequently on servers but aren't generally necessary for personal computers. RAID is generally configured as mirrored or striped. Mirrored RAID (Level 1) provides a fail-over drive. Striped RAID (Levels 0, 3, and 5) write data across multiple disk drives so that a single disk failure can be recovered from the data on the remaining drives. There are three (3) types of RAID systems: failure-resistant disk systems (that protect against data loss due to disk failure), failure-tolerant disk systems (that protect against loss of data access due to failure of any single component), and disaster-tolerant disk systems (that consist of two or more independent zones, either of which provides access to stored data).
Peripherals	Printer - Devices that print text or illustrations on paper. There are many different types of printers.
Peripherals	Scanner - Devices that can read text or illustrations printed on paper and translate the information into a form the computer can use. A scanner works by digitizing an image -- dividing it into a grid of boxes and representing each box with either a zero or a one, depending on whether the box is filled in.
LAN (Local Area Network) / Intranet	Ethernet - local-area network (LAN) architecture that uses a bus or star topology and supports data transfer rates of 10 Mbps, 100 Mbps (Fast Ethernet) or 1 Gbps (gigabit Ethernet). The Ethernet specification served as the basis for the IEEE 802.3 standard, which specifies the physical and lower software layers. Ethernet uses the CSMA/CD access method to handle simultaneous demands. It is one of the most widely implemented LAN standards.
Network Devices / Standards	Hub - A common connection point for devices in a network. Hubs are commonly used to connect segments of a LAN. A hub contains multiple ports. When a packet arrives at one port, it is copied to the other ports so that all segments of the LAN can see all packets.
Network Devices / Standards	Switch - In networks, a device that filters and forwards packets between LAN segments. Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called switched LANs or, in the case of Ethernet networks, switched Ethernet LANs.
Network Devices / Standards	Router - A device or setup that finds the best route between any two networks, even if there are several networks to traverse. Like bridges, remote sites can be connected using routers over dedicated or switched lines to create WANs.
Network Devices / Standards	Network Interface Card - Often abbreviated as NIC, an expansion board you insert into a computer so the computer can be connected to a network. Most NICs are designed for a particular type of network, protocol, and media, although some can serve multiple networks.

SERVICE STANDARD	SERVICE SPECIFICATION
Network Devices / Standards	Transceivers - Short for transmitter-receiver, a device that both transmits and receives analog or digital signals. The term is used most frequently to describe the component in local-area networks (LANs) that actually applies signals onto the network wire and detects signals passing through the wire. For many LANs, the transceiver is built into the network interface card (NIC). Some types of networks, however, require an external transceiver.
Network Devices / Standards	Gateway - Gateways are points of entrance to and exit from a communications network. Viewed as a physical entity, a gateway is that node that translates between two otherwise incompatible networks or network segments.
Network Devices / Standards	T1/T3 - T1 service delivers 1.544 Mbps. Typically channelized into 24 DS0s, each capable of carrying a single voice conversation or data stream. The European T1 or E1 transmission rate is 2.048 Mbps. A T3 circuit communicates at 45 Mbps, or 28 T1 lines.
Network Devices / Standards	Firewall – This refers to the network device that is designed to prevent unauthorized access to or from a private network. Firewalls can be implemented in both hardware and software, or a combination of both. Firewalls are frequently used to prevent unauthorized Internet users from accessing private networks connected to the Internet, especially intranets. There are several types of firewall techniques and firewalls may implement one or more simultaneously. Packet filtering inspects inbound and outbound packets, validating against defined business rules. Application gateways apply security rules against applications. Circuit-level gateways apply security rules against physical connection attempts to and from the network. Proxy servers mask the internal requestor by inspecting and augmenting the packet header. Four common architectures of firewalls include the packet filtering router, the screened host firewall system, the dual homed host firewall, and the screened subnet firewall (with a DMZ), which is one of the most secure implementations.

3.4.3 Component Framework

The Component Framework service area, as defined by the FEA TRM, includes the following categories:

- Security
- Presentation / Interface
- Business Logic
- Data Interchange
- Data Management

NBII uses multiple methods to protect information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction in order to provide integrity, confidentiality, and availability. NBII's Security Plan documents the management, operational, and technical controls intended to meet the protection requirements of the NBII systems. These controls include:

- Management Controls

- Risk Assessment and Management
- Review of Security Controls
- Rules of Behavior
- Planning for Security in the Life Cycle

- Operational Controls
  - Personnel Security
  - Physical and Environmental Protection
  - Production, Input/Output Controls
  - Contingency Planning
  - Application and Systems Software Maintenance Controls
  - Data Integrity/Validation Controls
  - Documentation
  - Security Awareness and Training
  - Incident Response Capability
- Technical Controls
  - Identification and Authentication
  - Logical Access Controls
  - Public Access Controls
  - Audit Trails

The NBII uses various technical controls to ensure the security of its information. The following table identifies the specifications, as defined in the FEA TRM, used by the NBII that are included in the Security service category.

Table 3-21. Security

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Certificates / Digital Signature	SSL (Secure Sockets Layer) - An open, non-proprietary protocol for securing data communications across computer networks. SSL is sandwiched between the application protocol (such as HTTP, Telnet, FTP, and NNTP) and the connection protocol (such as TCP/IP, UDP). SSL provides server authentication, message integrity, data encryption, and optional client authentication for TCP/IP connections.	NBII uses SSL protocol to manage the security of a message transmission on the Internet. SSL uses a program layer located between the Internet's Hypertext Transfer Protocol (HTTP) and Transport Control Protocol (TCP) layers. SSL is included as part of both the Microsoft and Netscape browsers

The NBII uses various methods to provide the connection between the biological information consumer and the NBII website and portal. The following table identifies the hardware, software, or specifications used by the NBII that are included in the Presentation / Interface service category.

Table 3-22. Presentation / Interface

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Static Display	HTML (Hyper Text Markup Language) - The language used to create Web documents and a subset of Standard Generalized Markup Language (SGML)	NBII uses HTML to display static pages that are the pre-defined graphical interface between the NBII website and biological information consumers.
Dynamic / Server-Side Display	JSP (Java Server Pages) - JSP is part of Sun's J2EE architecture and provide template capabilities for presenting dynamically generated Web content. JSPs are text files written in a combination of standard HTML tags, JSP tags, and Java code.	NBII uses JSP to control the content or appearance of certain Web pages. Servlets, small programs written in Java that run on the Web server, modify the Web page before it is sent to the user who requested it.
Dynamic / Server-Side Display	ASP (Active Server Pages) - A Web server technology from Microsoft that allows for the creation of dynamic, interactive sessions with the user.	NBII uses ASP, HTML pages that includes one or more scripts written in VBScript or Jscript that are processed on a Microsoft Web server, to control content or appearance of certain NBII web pages before the page is sent to the user.
Dynamic / Server-Side Display	ASP.Net (Active Server Pages .Net) - ASP.NET is a set of technologies in the Microsoft .NET Framework for building Web applications and XML Web Services. ASP.NET pages execute on the server and generate markup such as HTML, WML, or XML that is sent to a desktop or mobile browser.	ASP.NET (originally called ASP+) is the next generation of ASP. NBII uses ASP.NET to dynamically build Web pages on the fly by inserting queries to a relational database in the Web page. ASP.NET supports code written in compiled languages such as Visual Basic, C++, C#, and Perl. NBII uses these capabilities within the NBII Web Catalog, Dublin Core based, and Resource Tool.
Content Rendering	DHTML (Dynamic HTML) - A collective term for a combination of new Hypertext Markup Language (HTML) tags and options, style sheets, and programming that will allow Web pages that are more animated and more responsive to user interaction than previous versions of HTML.	NBII uses dynamic HTML to support the transformation of data for presentation on web pages.
Content Rendering	XHTML (eXtensible HTML (emerging)) - The W3C's recommendation for the next generation of HTML leveraging XML	NBII uses dynamic XHTML to support the transformation of data for presentation on web pages.
Content Rendering	Cascading Style Sheets (CSS) - A style sheet format for HTML documents endorsed by the World Wide Web Consortium. CSS1 (Version 1.0) provides hundreds of layout settings that can be applied to all the subsequent HTML pages that are downloaded.	NBII uses cascading style sheets to control the display of its web pages.

The NBII uses both platform independent and platform dependent software languages to develop software, scripts, or methods to enforce business rules within the NBII website and portal. The following table identifies the specifications used by the NBII that are included in the Business Logic service category.

Table 3-23. Business Logic

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Platform Independent	C, C++ - C is a procedure programming language. C++ is an object-oriented version of C that has been widely used to develop enterprise and commercial applications.	NBII can use C++ to develop ASP.Net code to dynamically control the presentation of web pages. Addition, the NBII portal's core engine for assembling Web services as well as Plumtree Search Server are compiled from C++, as is usually the case with search engines and other infrastructure; the portal's business logic has also been built in C++.
Platform Independent	JavaScript - A scripting language that runs within a web browser.	NBII can use JavaScript to code to dynamically control the presentation of web pages with JSP.
Platform Dependent (MS)	Visual Basic - A version of the BASIC programming language from Microsoft specialized for developing Windows applications.	Used by NBII to develop gadgets. Gadgets, or portlets, are small applications that are hosted on the Portal Service and run in the NBII portal to execute specific functionality. Can also be used to develop code supporting ASP.Net.
Platform Dependent (MS)	Visual Basic .NET - A version of the BASIC programming language from Microsoft specialized for developing Windows applications that is used within Microsoft's .NET environment.	Used by NBII to develop gadgets. Gadgets, or portlets, are small applications that are hosted on the Portal Service and run in the NBII portal to execute specific functionality. Can also be used to develop code supporting ASP.Net.
Platform Dependent (MS)	C# (C-Sharp) - An object-oriented programming language from Microsoft that is based on C++ with elements from Visual Basic and Java.	NBII can use C# to develop ASP.Net code to dynamically control the presentation of web pages. Addition, the NBII portal's core engine for assembling Web services as well as Plumtree Search Server are compiled from C++, as is usually the case with search engines and other infrastructure; the portal's business logic has also been built in C#.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Platform Dependent (MS)	VB Script - A scripting language from Microsoft. A subset of Visual Basic, VBScript is widely used on the Web for both client processing within a Web page and server-side processing in Active Server Pages (ASPs).	NBII can use VBScript to develop ASP scripts to dynamically control the presentation of web pages.

The NBII supports the sharing of data between biological information contributors and consumers. The following table identifies the specifications used by the NBII that are included in the Data Interchange service category.

Table 3-24. Data Interchange

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Data Exchange	XMI - Enables easy interchange of metadata between modeling tools (based on the OMG UML) and metadata repositories (OMG MOF based) in distributed heterogeneous environments. XMI integrates three key industry standards: XML, UML, and MOF. The integration of these three standards into XMI marries the best of OMG and W3C metadata and modeling technologies, allowing developers of distributed systems to share object models and other metadata over the Internet.	NBII uses XMI (XML Metadata Interchange) to provide a standard way to exchange information about clearinghouse metadata.
Data Exchange	XQuery – A language used for processing and evaluating XML data. The Xquery language provides results of expressions allowing the use of evaluations to the implementation of XQuery.	NBII uses Xquery to evaluate clearinghouse metadata.
Data Exchange	SOAP (Simple Object Access Protocol) – SOAP provides HTTP/XML based remote procedure call capabilities for XML Web Services.	NBII uses SOAP to communicate between platforms using HTTP XML as the mechanisms for information exchange. Additionally, the NBII Portal uses SOAP to support its web crawler service.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Data Exchange	RDF (Resource Description Framework (emerging)) - RDF provides a lightweight ontology system to support the exchange of knowledge on the Web. It integrates a variety of web-based metadata activities including sitemaps, content ratings, stream channel definitions, search engine data collection (web crawling), digital library collections, and distributed authoring, using XML as interchange syntax. RDF is the foundation for the Semantic Web envisioned by Tim Berners-Lee -an extension of the current web in which information is given well-defined meaning, better enabling computers, and people to work in cooperation.	The Resource Description Framework (RDF) is a general framework for how to describe any Internet resource such as a Web site and its content. An RDF descriptions used by the NBII (e.g., metadata, or "data about data") include information that describes the available biological content described in the NBII Metadata Clearinghouse.

The NBII manages contributed data and information, providing data administration and establishing the standards for defining data and the way in which biological information consumers will access it. The following table identifies the specifications used by the NBII that are included in the Data Management service category.

Table 3-25. Data Management

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Database Connectivity	JDBC (Java Data Base Connectivity) - JDBC provides access to virtually any tabular data source from the Java programming language. It provides cross-DBMS connectivity to a wide range of SQL databases, and other tabular data sources, such as spreadsheets or flat files.	The NBII portal uses Java Database Connectivity (JDBC) to retrieve portal user identity and group affiliation information stored in the portal database.
Database Connectivity	ODBC (Open Database Connectivity) - A database programming interface from Microsoft that provides a common language for Windows applications to access databases on a network. ODBC is made up of the function calls programmers write into their applications and the ODBC drivers themselves.	NBII uses ODBC, an open standard application programming interface (API), to access various NBII databases.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Database Connectivity	ADO (Active Data Objects) - A programming interface from Microsoft that is designed as "the" Microsoft standard for data access. First used with Internet Information Server, ADO is a set of COM objects that provides an interface to OLE DB. The three primary objects are Connection, Command, and Recordset.	NBII uses ADO to get access to relational or non-relational databases.
Database Connectivity	ADO.Net (Active Data Objects .Net) - ADO.NET is the data-access component of the Microsoft's .NET Framework. It provides an extensive set of classes that facilitate efficient access to data from a large variety of sources, enable sophisticated manipulation and sorting of data.	NBII uses ADO to get access to relational or non-relational databases.
Reporting and Analysis	OLAP (On-Line Analytical Processing) - Decision support software that allows the user to quickly analyze information that has been summarized into multidimensional views and hierarchies.	NPII uses OLAP to support the extract and viewing of geospatial data.

3.4.4 Service Interface and Integration

The Service Interface and Integration service area, as defined by the FEA TRM, includes the following categories:

- Integration
- Interoperability
- Interface

Integration enabled elements of distributed business applications to interoperate. NBII provides database access is through the use of native database Application Programming Interfaces (APIs), client-side APIs, or server-side database gateways. The following table identifies the specifications used by the NBII to provide database access that are included in the Integration service category.

Table 3-26. Integration

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Middleware	PL/SQL – Oracle's procedural extension to industry-standard SQL.	Some NBII nodes use PL/SQL, procedural language extension to Structured Query Language (SQL), to access data stored in Oracle databases.
Middleware	ISQL/w – Microsoft's implementation of ANSI SQL.	Can be used to access data in NBII core and database applications (e.g., portal, expertise, web resources, GIS, etc.)

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Middleware	OPEN ANSI SQL/92 (ISO/IEC9075:1992 /ANSI X3.135-1992) – SQL is the information processing industry standard language of relational database management systems (RDMS). ANSI X3.135-1992 (also referred to as SQL-92 and ANSI SQL) is the industry standard for Database Language SQL. This standard promotes the portability and interoperability of database application programs and facilitates maintenance of database systems across heterogeneous data processing environments. SQL-92 provides a standardized way for embedding SQL statements into application development languages.	Can be used to access data in NBII core and database applications (e.g., portal, expertise, web resources, GIS, etc.)

Interoperability provides the capabilities of discovering and sharing data and services across the NBII. The following table identifies standards used by the NBII that are included in the Interoperability service category.

Table 3-27. Interoperability

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Data Format / Classification	XML (eXtensible Markup Language) – XML has emerged as the standard format for web data, and is beginning to be used as a common data format at all levels of the architecture. Many specialized vocabularies of XML are being developed to support specific Government and Industry functions.	The NBII uses XML as clearinghouse metadata format. Additionally, the NBII portal stores data about users, services, and content as XML in a relational database. The portal's application integration components, portlets, can output HTML or XML although the majority of portlets output HTML. NBII also uses XML to support data exchange, harvesting, and interoperability in applications related to Invasive Species, Web catalog records, and GIS Applications.
Data Format / Classification	Namespaces – Namespaces are qualified references to URI (Uniform Resource Identifier) resources within XML documents.	In general, a namespace uniquely identifies a set of names so that there is no ambiguity when objects having different origins but the same names are mixed together. Both the NBII Metadata Clearinghouse and the NBII Portal use XML namespaces to uniquely identify collection of element types and attribute names.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Data Types / Validation	DTD (Document Type Definition) – DTD is used to restrict and maintain the conformance of an XML, HTML, or SGML document. The DTD provides definitions for all tags and attributes within the document and the rules for their usage. Alterations to the document are validated with the referenced DTD.	The NBII developed a DTD to define the tags and attributes of the Metadata Clearinghouse XML. DTD also exist for the NBII Dublin Core Resource Catalog Standard, Invasive Species experts, databases, and focal points. Additional DTD are in use by NBII Nodes to support local or regional data issues.
Data Types / Validation	XML Schema – XML Schemas define the structure, content, rules, and vocabulary of an XML document. XML Schemas are useful in automation through embedding processing rules.	XML Schemas define the content, rules, etc. of the XML documents contained in the Metadata Clearinghouse, web resources catalog, invasive species database, GIS database applications, etc.
Data Transformation	XSLT (eXtensible Stylesheet Language Transform) - Transforms XML document from one schema into another. Used for data transformation between systems using different XML schema, or mapping XML to different output devices.	The NBII uses XSL Transformations (XSLT) as a standard way to describe how to transform (change) the structure of an XML document for presentation in a web page.

Interfaces provide the means for communicating, transporting and exchanging information through a common dialog or method. The following table identifies the hardware, software, or specifications used by the NBII that are included in the Interface service category.

Table 3-28. Interface

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Service Discovery	UDDI (Universal Description Discovery and Integration) - UDDI provides a searchable registry of XML Web Services and their associated URLs and WSDL pages.	The NBII uses UDDI to located resources on the Web. The NBII Portal supports web service interoperability using UDDI and currently is deploying a UDDI Registry to support all NBII resources including: web resources, museum collections, GIS Layers, etc.
Service Description / Interface	WSDL (Web Services Description Language) - WSDL is an XML based Interface Description Language for describing XML Web Services and how to use them.	The Web Services Description Language (WSDL) is an XML-based language used by the NBII portal services to provide a way for those services to be accessed.

SERVICE STANDARD	SERVICE SPECIFICATION	NBII SPECIFICS
Service Description / Interface	API (Application Program Interface) / Protocol - A language and message format used by an application program to communicate with the operating system or some other control program such as a database management system (DBMS) or communications protocol. APIs are implemented by writing function calls in the program, which provide the linkage to the required subroutine for execution. Thus, an API implies that some program module is available in the computer to perform the operation or that it must be linked into the existing program to perform the tasks.	API's support the integration of various NBII components.

3.5 Summary

The NBII provides a mechanism that expands the universe of data and information readily available to biological information consumers. Delivery of knowledge management, technology management, and program management services by the NBII Program are supported by both core and enabling technology services and the IT components that support those services. Continued realization of the mission of the NBII will include future modifications and enhancements to the technology framework that supports NBII services through the building on the existing capabilities, leveraging existing federal and non-federal partner capabilities, and investments by the NBII Program.